

What is claimed is:

1. A method of updating a tap coefficient of a channel equalizer,
comprising:

determining whether or not an error of the channel equalizer converges within
a range of a threshold of visibility; and

updating the tap coefficient of the channel equalizer using a least mean square
(LMS) algorithm

if the error converges within the range of the threshold of visibility or

if the error does not converge within the range of the threshold of visibility
and a control signal is in a first state; or

updating the tap coefficient of the channel equalizer using a Kalman algorithm
if the error does not converge within the range of the threshold of visibility and the
control signal is in a second state.
2. A method of updating a tap coefficient of a channel equalizer
according to claim 1, wherein:

determining whether or not an error of the channel equalizer converges within
a range of a threshold of visibility includes determining whether a square of the error
of the channel equalizer is smaller or larger than the threshold of visibility.
3. A method of updating a tap coefficient of a channel equalizer
according to claim 1, wherein:

the second state of the control signal is a training signal.

4. A method of updating a tap coefficient of a channel equalizer

according to claim 3, wherein:

the error is a difference between the training signal and a signal output from the channel equalizer.

5. A method of updating a tap coefficient of a channel equalizer

according to claim 1, wherein:

the error is a difference between a channel equalizer output signal and a determination circuit output signal, wherein the determination circuit output signal has a certain value corresponding to the channel equalizer output signal.

6. A method of updating a tap coefficient of a channel equalizer

according to claim 1, wherein:

when the tap coefficient of the channel equalizer is updated using the LMS algorithm, the tap coefficient is updated with the following equation:

$$c(n) = c(n-1) + \mu e(n)y(n)$$

and further wherein $c(n)$ denotes an updated tap coefficient vector of the channel equalizer, $c(n-1)$ denotes a tap coefficient vector of the channel equalizer that will be updated to obtain $c(n)$, μ denotes a step size, $e(n)$ denotes an error of the channel equalizer and $y(n)$ denotes data input to the channel equalizer.

7. A method of updating a tap coefficient of a channel equalizer according to claim 1, wherein:

when the tap coefficient of the channel equalizer is updated using the Kalman algorithm, the coefficient is updated with the following equation:

$$c(n) = c(n-1) + K(n)e(n)$$

and further wherein $c(n)$ denotes an updated tap coefficient vector of the channel equalizer, $c(n-1)$ denotes a tap coefficient vector of the channel equalizer updated to obtain $c(n)$, $K(n)$ denotes a Kalman gain vector and $e(n)$ denotes an error of the channel equalizer.

8. A circuit for updating a tap coefficient of a channel equalizer comprising:

a convergence examining and comparing (CEC) unit arranged and configured to determine if a received error of the channel equalizer converges within a range of a threshold of visibility; and

an updating circuit arranged and configured to update the tap coefficient using a LMS algorithm when the error converges within the range of the threshold of visibility or when the error does not converge within the range of the threshold of visibility and a control signal is in a first state, and

using a Kalman algorithm when the error does not converge within the range of the threshold of visibility and the control signal is in a second state.

9. A circuit for updating a tap coefficient of a channel equalizer

according to claim 8, wherein:

the updating circuit updates the tap coefficient of the channel equalizer using the Kalman algorithm only when the second state of the control signal is a training signal.

10. A circuit for updating a tap coefficient of a channel equalizer

according to claim 8, wherein:

the updating circuit is arranged and configured to update the tap coefficient of the channel equalizer using the LMS algorithm by executing an equation

$$c(n) = c(n-1) + \mu e(n)y(n)$$

wherein $c(n)$ denotes an updated tap coefficient vector of the channel equalizer, $c(n-1)$ denotes a tap coefficient vector of the channel equalizer updated to obtain $c(n)$, μ denotes the step size, $e(n)$ denotes an error of the channel equalizer and $y(n)$ denotes data input to the channel equalizer.

11. A circuit for updating a tap coefficient of a channel equalizer

according to claim 8, wherein:

the updating circuit is arranged and configured to update the tap coefficient of the channel equalizer using the Kalman algorithm by executing an equation

$$c(n) = c(n-1) + K(n)e(n)$$

wherein $c(n)$ denotes an updated tap coefficient vector of the channel equalizer, $c(n-1)$ denotes a tap coefficient vector of the channel equalizer that will be updated to obtain $c(n)$, $K(n)$ denotes a Kalman gain vector and $e(n)$ denotes an error of the channel equalizer.

12. A circuit for updating a tap coefficient of a channel equalizer comprising:

a channel equalizer arranged and configured to produce a channel equalizer output signal;

a slicer arranged and configured to determine a certain value corresponding to the channel equalizer output signal and generate a slicer output signal corresponding to the certain value;

a selection circuit arranged and configured to receive a control signal, the slicer output signal and a training signal, and, in response to the control signal, output the slicer output signal or the training signal as a selection circuit output signal;

a subtracter arranged and configured to subtract the channel equalizer output signal from the selection circuit output signal and generate an error output signal;

a convergence examining and comparing (CEC) unit arranged and configured to compare a range of the threshold of visibility with the error output signal and generate a first CEC output signal when the error output signal converges within the range of threshold of visibility or a second CEC output signal when the error output signal does not converge within the range of the threshold of visibility;

a decoder arranged and configured to receive the control signal and the output signal of the CEC unit and produce a decoder output signal; and

an updating circuit arranged and configured to update the tap coefficient of the channel equalizer in response to the decoder output signal,

wherein the updating circuit updates the tap coefficient of the channel equalizer

using a LMS algorithm when the decoder output signal is in a first state and

using a Kalman algorithm when the decoder output signal is in a second state.

13. A circuit for updating a tap coefficient of a channel equalizer according to claim 12, wherein:

the decoder signal output is in the first state when the error output signal converges within a range of the threshold of visibility or the control signal is in a first state; and

the decoder signal output is in the second state when the error output signal does not converge within a range of the threshold of visibility and the control signal is in a second state.

14. A circuit for updating a tap coefficient of a channel equalizer according to claim 13, wherein:

when the control signal is in the second state, the selection circuit output signal is the training signal.

15. A circuit for updating a tap coefficient of a channel equalizer according to claim 12, wherein:

a first portion of the updating circuit is arranged and configured to update the tap coefficient of the channel equalizer using the LMS algorithm by executing an equation

$$c(n) = c(n-1) + \mu e(n)y(n)$$

and

a second portion of the updating circuit is arranged and configured to update the tap coefficient of the channel equalizer using the Kalman algorithm by executing an equation

$$c(n) = c(n-1) + K(n)e(n)$$

wherein $c(n)$ denotes an updated tap coefficient vector of the channel equalizer, $c(n-1)$ denotes a tap coefficient vector of the channel equalizer that will be updated to obtain $c(n)$, μ denotes the step size, $e(n)$ denotes an error of the channel equalizer, $y(n)$ denotes data input to the channel equalizer and $K(n)$ denotes a Kalman gain vector.

16. A circuit for updating a tap coefficient of a channel equalizer comprising:

a channel equalizer arranged and configured to produce a channel equalizer output signal;

means for generating a determination signal corresponding a value of the channel equalizer output signal;

means for receiving a control signal, the determination signal and a training signal and selectively outputting the determination signal or the training signal;

means for generating an error signal;

means for comparing the error signal to a threshold of visibility and generating a comparator output signal; and

means for selectively updating the tap coefficient using a LMS algorithm or a Kalman algorithm based on a control signal state and a comparator output signal state.

17. A circuit for updating a tap coefficient of a channel equalizer according to claim 16, wherein:

the means for generating the determination signal is a slicer;

the means for receiving the control signal, the determination signal and the training signal is a multiplexer;

the means for generating the error signal is a subtracter; and

the means for comparing the error signal to a threshold of visibility and generating the comparator output signal is a convergence examining and comparing unit.